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RICE BREEDING PROGRAM IN EGYPT

M.A. Koshairy[1]
C. L. Pan[2] and
Gad el Hak[3]

RICE is one of the most important crops in Egypt. Its annual acreage varied from some 330,000 hectares in 1948 to 150,000 hectares in 1952, according to the availability of water supply in the Nile. The average yield from 1949 to 1950 was estimated at 3,733.33 kilograms per hectare which is high compared to a number of the more important rice-producing countries.

The climate in Egypt is apparently more favorable to the growing of *japonica* rice than *indica* rice. Rice is grown mostly in the Northern Delta and is planted in late April or in May and harvested in October. Most farmers are now using the transplanting method, although in some areas, particularly where labour is scarce, broadcasting is still the role.

Agriculture in Egypt depends entirely on irrigation due to the extreme scarcity of rainfall, and so does the cultivation of rice. The Nile is the sole source of water supply which becomes very low from May to July, but by the beginning of August, the flood from the Nile arrives, and thence the water supply will suffice until next spring. The shortage of water during the critical period from May to July is the limiting factor for

1 Chief Plant Breeder and Director of the Plant Breeding Section

2 FAO Rice Expert in Egypt, and

3 Chief of the Rice Branch of the Plant Breeding Section

rice growing. More water available in this period, usually more area will be planted to rice.

The rice land located in the nothernmost part of the delta area is usually very salty. And, furthermore, land newly reclaimed from lakes is often found to be too saline to grow any crop other then rice. It is, therefore, obvious that a variety that can stand the highly saline conditions is very much in demand.

Usually a great part of the rice produced in this country is exported, mostly to European countries where people prefer long-grain rice. But the rice produced in Egypt is of the short-grain type.

With this brief review of the rice production situation, it is obvious that the rice breeding program in the country should be developed along the following lines:

1. to breed a high yielding variety of *japonica* type for general cultivation;
2. to breed a variety highly tolerant to saline conditions for cultivation in the northernmost regions;
3. to breed a variety of long grain for export; and
4. to breed a variety that can be grown with reduced irrigation during the period from May to July.

Breeding for high yield. Rice grown in this country is of the *japonica* type, called Yabani which means Japanese. Improved varieties from selections were released many years ago. The most well known of them are Yabani Pearl and Yabani Mont. 7, which yield much higher than the varieties grown by the farmers, such as Yabani 15. More recently some additional varieties like Giza 14 which is a selection from the cross, Yabani Pearl x Iraki 16, have also been released.

The Plant Breeding Section has been continuously working on new selections and introductions, in the hope to find a better variety. From 1951 to 1953, a total of 51 trials, including many new materials, was carried out in 9 different stations. The varieties in each trial were arranged in randomized blocks with not more than 25 varieties in each block, each variety generally being replicated 6 times. The average yield of the best 9 varieties in these trials is given below.

Table 1.
Average Yield of Best 9 Varieties tested in 1951–1953.
(100 kgs./hectare)

Name of the variety	*Average yield*
Giza 20	67.66 ± 91
Yabani Mint. 13	67.62 ± 71
Giza 17	67.37 ± 91
Giza 18	67.17 ± 71
Yabani Mont. 47	66.86 ± 71
Giza 19	66.46 ± 71
Yabani Pearl	64.43 ± 71
Giza 14	64.00 ± 71
Yabani mont. 7	63.97 ± 71

The significant difference between the *yield* of Yabani Mont. 47 and that of Yabani Pearl at 5% level is equal to $2 \times V\ 2 \times .71 = 2.00$ or 200 kilograms per hectare. Actually, Yabani Mont. 47 out-yielded Yabani Pearl by 243 kilograms per hectare which was, therefore, significant. Yabani Mont. 47 also significantly out-yielded Yabani Mont. 7 and Giza 14, both of which have been recommended as improved varieties.

Since the range of adaptability of a variety is another important factor to be considered, the following is a list of the best 3 varieties at each station arranged according to their adaptabilities :

Table 2. The Best 3 Varieties at Each Station.

Locality	*First best variety*	*Second best variety*	*Third best variety*
Gemmeiza	Giza 18	Y.M. 13	Y. Pearl
Sids	Y.M. 13	Giza 17	Giza 19
Damanhour	Giza 18	Y.M. 13	Giza 14
Abo Hommad	Y.M. 47	Giza 18	Giza 14
Moshtohour	Giza 17	Giza 14	Giza 20
Sakha	Giza 19	Y.M. 47	Giza 18
Sirw	Y.M. 13	Giza 14	Y.M. 47
Adfina	Giza 17	Y.M. 47	Giza 19
Abo Hommus	Y.M. 7	Giza 19	Y.M. 47

If we give a grade of 3 to the best variety, 2 to the second best and 1 to the third best, we would then have the following indices for the range of their adaptabilities.

Table 3. The Ranks of Varieties and the Indices of their Adaptabilities.

	Number of stations where varieties were tested :			*Index of*
Name of variety	*The 1st best*	*The 2nd best*	*The 3rd best*	*adaptability*
Y.M. 13	2	2	0	10
Giza 18	2	1	1	9
Yabani mont. 47	1	2	2	9
Giza 17	2	1	0	8
Giza 19	1	1	2	7
Giza 14	0	2	2	6
Y.M. 7	1	0	0	3
Yabani Pearl	0	0	1	1
Giza 20	0	0	1	1

Y.M. 13 topped the list, while Yabani Mont. 47 was a close second, Ywith abani Pearl and Yabani Mont. 7 at the bottom of it.

After reviewing the yield data obtained from each station, it was found that usually there were no real significant differences between the first three best varieties. From Table 2 it was proved that Yabani Mont. 47 was one of the best varieties at each of the five stations where it was tested and that all these stations are located in the most improtant rice growing regions of the country. The field observations further indicated that Yabani Mont. 47 was very resistant to shattering, and often did well when it was sown late in the season. It seems safe to conclude that Yabani Mont. 47 is the variety most suitable for recommendation for general cultivation.

Breeding for tolerence to saline conditions. The land on the Government Farm at Sirw, being recently reclaimed, is very salty. Breeding for saline tolerant varieties has been conducted there. In 1953 a trial consisting of 6 promising varieties was conducted in two plots, one being newly reclaimed and the other being reclaimed several years ago and considered as normal fertile soil. The yield data are given below.

Table 4. The Yield of 6 Varieties grown in the Fertile and in the newly Reclaimed Plots. (100 kgs./hectare)

Variety	*In the fertile plot*	*In the newly reclaimed plot*
Agami Mont. 2	47.77	29.66
U.S. 38	41.17	26.37
Agami Mont. 1	53.42	23.43
Yabani Mont. 47	67.40	20.57
Giza 14	63.80	9.94
Yabani Pearl	60.63	2.11
S.D. at 5%	6.34	5.60

Yabani Mont. 47 gave the highest yield when it was grown in the fertile land, but on the saline soil Agami Mont. 2 was the best yielder.

Due to the shortage of water in 1953, the experimental plots were subject to a severe drought for a period of two weeks in June. Salinity plus drought made it difficult for the plants to grow, but on the other hand it became an ideal situation for a study of saline tolerances of the plants. Towards the end of June, a reading was taken on the experiment conducted in the newly reclaimed plot. The grade used in the reading was from 1 to 5, with 1 for varieties with almost a normal growth, and 5 for varieties most severely affected by salinity. The results are given in the following table:

Table 5. Varietal Reaction to Salinity.

Variety	Replications I	II	III	Average
Yabani Pearl	4	4	4	4.0
Y. Mont. 47	2	3	2	2.3
Giza 14	5	4	4	4.3
Agami Mont. 1	2	1	1	1.3
Agami Mont. 2	2	3	2	2.3
U.S. 38	3	2	5	3.3

Agami Mont. 1 appeared to be most tolerant to salinity, with Agami Mont. 2 and Yabani Mont. 47 as the next in order. Yabani Pearl and Giza 14 suffered the most. This reading on tolerence was in general agreement with the yield tests of the varieties under observation. So Agami variety has been recommended as the most suitable one for saline conditions and in fact it is grown in most of the saline soils.

Breeding for long–grain variety. People in Europe generally prefer long–grain rice, but the rice produced in Egypt is unfortunately short–grained. It is therefore the government's policy to promote the production of long–grain varieties for export for a higher price.

A Javanese variety, called Java 3, was first introduced from Java by Dr. M.T. Hefnawy in the early 40's. The average length of the grain is 7.75 mm. as compared with only 5.00 mm. for most of the local standard varieties, such as Yabani Mont. 47. But it matures late and the yield is low.

A cross was then made between Java 3 and Yabani Mont. 3 several years ago in an attempt to produce a strain of long grain with normal yield and maturity. Several plants had been selected from each of several F7 families grown in 1952, and they were tested in a yield trial at both Gemmeiza and Sakha in 1953. Besides 40 families selected from this cross, a few other varieties were also included in this trial. Each family or variety was planted in a plot of 5 rows, replicated 4 times.

The yield and the length of grain of the best families of the cross and of Yabani Mont. 47 is given below.

Table 6. The Yield and the Length of Grain of the Best Families of the Cross and of Yabani Mont. 47.

Variety and the Family	Yield in 100 kgs./hectare At Gemmeiza	At Sakha	Average	Length of grain (mm.)
Yabani Mont. 47	79.46	80.02	79.74	5.26
Family 28	74.43	63.88	69.16	7.04
Family 5	61.11	58.17	59.64	7.29
S.D.	15.79	11.26	9.70	

There was no significant difference in yield between the Family 28 and Yabani Mont. 47 at Gemmeiza but at Sakha the difference was very striking. The grain of the Family 28 was 7.04 mm. long, much longer than that of Yabani Mont. 47, which was only 5.26 mm. in length.

Further tests were conducted on those long-grain strains in 1954. New crosses were also made in 1953 of Yabani Mont. 47 with long-grain varieties, including Java 3 and some additional varieties from the U.S.A.

Breeding for drought resistance. As it is mentioned earlier, the rice acreage in Egypt is limited by the amount of water available in the Nile during the months between May and July. A program has been started since 1953 to breed for drought resistance. Many varieties of upland rice were introduced through the kindness of FAO from Japan, the Philippines and Formosa. Some of them which were received in time were grown together with Yabani Pearl at Giza in a field, which was irrigated once every two weeks from the time of planting to August 6, the day when the flood from the Nile arrived, and the field was thence kept continuously flooded as usual.

Field observations indicated that a variety, called Y.N.A. 44, appeared much better in growth than Yabani Pearl, and its yield was also encouraging. However, we cannot present the yield data here, as this trial was conducted in 1953, with no replications, due to the small quantity of seeds received. In 1954 three similar trials, each with 7 varieties replicated 4 times, were conducted at Sakha, Sids, and Giza.

THE MECHANICAL CULTIVATION OF WET PADI IN MALAYA

E.F. Allen, *Senior Agronomist*

and

D.W.M. Haynes, *Agricultural Engineer*

Introduction. A detailed review of investigations into the mechanical cultivation of wet padi in Malaya was published in 1953 (1) and subsequent harvesting trials have been described (3). Methods of calculating costs have been stated in full (4) and, more recently, transport methods within padi areas have been surveyed (5).

The purpose of this paper is to summarize recent work in Malaya for the convenience of delegates to the fourth session of the International Rice Commission. Full use has been made of a recent unpublished progress report circulated within the Federation of Malaya (7)

The objects of mechanising wet padi cultivation are:

(1) To permit larger holdings per family in newly opened up areas.

(2) To make padi growing less laborious.

(3) To break the dependence of certain northern States on migrant labour for harvesting.

The first of these objects is the most important on a long–term basis but the public has required extension officers to pay some attention to the second.

The Present Position. Investigations commenced in 1948 and during the last 1953–54 padi season some 4,250 acres were cultivated mechanically, mainly by contract services, while 200 tons of padi were harvested mechanically in Departmental trials. The outstanding problem still requiring solution is the development of a harvesting unit smaller than the combine–harvester.

Type of Power Unit. No satisfactory prime mover for the individual smallholder has been found although many types of rotary hoes and walking tractors have been tried. Most of these are underpowered for Malaya conditions and it is difficult to combine sufficient power with a reasonably low price.

For contractors in established areas a compromise is necessary between high power and small size without affecting reliability. The power requirement would seem to be about twice that required on dry–land cereal farms outside the tropics. Existing fields and paths are small, thus tractors must also be smaller, especially since they may have to use temporary wooden bridges. It is often very difficult to move track–tractors between fields and their use has been mainly confined to reclamation work.

Padi farms designed specifically for mechanical cultivation do not yet exist but a 50–acre unit is planned in a new area and work should commence within two months. This will be a pilot scheme to determine costs.

Of the wheeled tractors used to date, the various Ferguson models are the most common and are very satisfactory. The new Fordson Major, especially the diesel–powered model, and the Farmall H are both satisfactory on all but the smallest plots. The old type of Fordson Major is unsuitable while the Farmall A is underpowered and has wheels which are too small.

Several types of track–tractors have been used satisfactorily for reclamation work in dry weather. The International–Harvester TD. 6, the Bristol 20, the Caterpillar D. 2 and D. 4 and the David Brown Trackmaster tractors have all been used satisfactorily on wet land, especially for after–cultivation, and the last named is outstanding in this class. The Platypus Bogmaster is now under test and shows very considerable promise, especially with a rotavator and for after–cultivation.

The Ransome M.G. 5 has been used on dry bog soils and it has performed well but there are no really good implements to match. The M.G. 6 has not yet been tested.

The Cuthbertson Water Buffalo can work on very soft, wet soils but no suitable matching implement has been developed and it is too large for small farms.

Modifications to Tracks and Wheels. On bottomless mineral soils, track layers with wide plates or swamp blocks are successful but wide wheels are less satisfactory.

Where there is a hard pan near the soil surface standard steel wheels are good, especially with wheel strakes. Pneumatic tyres are also successful but there is great variation in the tread pattern of different makes and careful selection is necessary. Wide drum or lattice wheels are not normally used since they make ploughing difficult. However, narrow–rimmed, large–diameter wheels are very effective under certain conditions but the performance of oversized pneumatic tyres with rice treads has been disappointing.

Bombardier half–tracks are of outstanding value under bad condition: they may permit cultivation work to extend both earlier and later in the season and so increase tractor utilization.

Under all conditions mounted-implements are favoured, especially on small plots.

Animal Drawn Implements. Two types of imported steel ploughs have been tested but were not acceptable to local ploughmen. New types are being imported from India and other countries and local ploughs have been fitted with steel bodies. A small 700 lbs. dynamometer has been built and has proved successful, thus more extensive tests will now be possible.

Preparation of Padi Land. For initial cultivation mould board ploughs are preferred where there are no underground timbers, especially when there is a dense off-season growth to turn in, but where timber is present disc-ploughs are used.

The Rotoplough, a power-driven disc harrow-plough, has shown great promise in early trials, especially on swampy, bottomless soils, but it is still in the prototype stage.

Ploughing is often slow where there is heavy growth to turn in and the use of a heavy disc-harrow is sometimes preferred. A preliminary slashing with a mechanical brush-cutter may facilitate the first disc-harrowing.

For after-cultivation, the best implement to use is a mounted or trailed Kedah roll. Light disc-harrows break down clods very well provided that the land is either dry or flooded but they are useless when the land is merely wet.

Application of Fertilizers. Phosphorus and potassium fertilizers are normally applied before planting or before the final cultivation. This operation is usually carried out by hand-broadcasting but standard manure distributers may also be used.

Most of the nitrogen is best applied after planting, either by hand placement in the soil or by broadcasting. Both are hard operations at present but granular fertilizers could be broadcast with a seed fiddle.

Pelleted fertilizers are very expensive and it seems unlikely that they will have practical application.

Seeding or Planting. Seed fiddles of various types are being used and these have given very good results using seed soaked for 48 hours, germinated for a further 36 hours and then dried off with rock phosphate. Seed rates as low as 20 lbs. per acre (22.4 kgs. per ha.) have given good results. Fiddles are very simple, cheap seeders and they give a swath width of 19

to 22 ft. with a seeding rate of 3 acres per hour under good conditions.

Drills have not been used successfully for wet padi but the types tested were obsolete. However, drilling gives good results with dry padi.

Little progress has been made with the development of transplanters but we are very interested in the new Italian machines.

Weed Control. Weeds are best controlled by well-timed cultivation before planting followed by careful water-control afterwards. Selective herbicides have been used experimentally but, until recently, the difficulty of application has been a check to extension. Dusts have been applied with engine-driven knapsack dusters but it is more efficient to use sprays. Very recently boom-sprayers have been used quite successfully with a two-man team, each with a pressure retaining knapsack sprayer (Favori-Colibri No. 9) joined to a common light 12 or 16 ft. boom by means of short-lengths of rubber hose.

We have still a lot to learn about the relative value of different herbi cides, optimum dosage rates and their effect on padifield fish.

Harvesting Operations. In large padi areas, reaping is normally carried out by sickle. No attempt has been made to develop a buffalo or ox-drawn reaper but these are not even used with rice in northern Italy (6).

Trials last season with prototype headers were not successful but the McConnel-Jay corn windrower showed promise.

The Massey Harris Rice Special Self-propelled Combine on tracks was tested last harvest in the north of Malaya and performed quite well in large fields. The working rate varied from 0.35 to 1.25 acres per hour with an average of 0.56 acres per hour, which is equivalent to perhaps 190 acres per unit per season. The cost varied greatly with conditions of the crop, averaging about the same as for hand harvest or 15 to 20 per cent of the value of the crop. In good conditions the cost can be much cheaper than hand harvesting.

Where reapers are used mechanical threshers will be required. The use of hand or foot-operated threshers is not the answer since their performance is little better than that of hand threshing by traditional methods.

The small engine-driven Tullos thresher reduces labour and increases output but does not reduce cost. The Andes has a low output and costs are therefore high; it can however be fully mounted on a tractor so that it can follow the reaper into fields. Unfortunately it is badly made and we have found it to be dangerous.

The Danish Andro has a high output but is rather too large and expensive for smallholders.

For contractors and large farmers the medium–sized Turner thresher does satisfactory work but is not manoeuvrable. The similar Garvie has not yet been fully tested but will probably be equally satisfactory. There is an urgent need for a fully–mounted medium–sized thresher and this may have to be developed locally but a Danish manufacturer is willing to produce a semi–mounted machine.

The cost of threshing with a Turner varies from 5 to 10 per cent of the value of

the crop according to whether it has been reaped by hand–knife (*tuai*) or sickle.

Winnowing. Locally made wooden winnowers are available but their output is somewhat too low for integration with mechanical harvesting. Winnowing fans are becoming common and several types have been developed; these are driven by hand, by foot pedals or by a small engine.

Spares, Advisory and Training Services. Agents are becoming increasingly co–operative and the importance of good spares and advisory services is now fully realized. These factors have had a marked influence on past sales and we have relatively small grave–yards of unserviceable or unsuitable tractors and implements by comparison with those in some other countries (2).

The training of operators and drivers has been undertaken partly by Government, partly by agents and partly by a special organization known as the Rural and Industrial Development Authority.

Discussion. The Department of Agriculture's mechanical investigations have some–times been criticized by the press on the grounds that trials have been prolonged at the expense of early practical application. Progress has admittedly been limited by inadequate staff and money but we have always been fully conscious of the dangers of over–hasty application of mechanisation to existing farms; it should be relatively easy to mechanise new padi areas in order to increase the size of holdings. A pilot scheme in one such new padi area is about to be started and the first crop should be planted next year.

It is gratifying to note that our cautious approach to padi mechanisation is fully in line with views expressed recently by an F.A.O. specialist (2).

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MINERALISING ACTION OF LIME ON SOIL NITROGEN IN WATER LOGGED RICE SOILS

C.T. Abichandani and S. Patnaik

Central Rice Research Institute, Cuttack, India

Nitrogen in rice soils mostly exists in organic form, there being only small amounts present in inorganic form as NH_3 or NO_3 nitrogen. This organic form of nitrogen, during the period of water logging, undergoes decomposition by soil micro-organism and gets gradually converted to and accumulates in soil in NH_3–N form to be made available for uptake by plants. Most of the organic nitrogen in rice soils appears rather resistant to conversion to NH_3–N form as only a fraction of this gets mineralised, even after 10 to 15 weeks of water logging. Increase in the microbiological activity of soil is brought about by changing soil reaction to slight alkalinity, by addition of lime. This helps decomposition of soil organic matter and releases more nitrogen to be made available to the crop. Harada and his co-workers in Japan have reported beneficial effects of addition of lime in large doses in water logged soils and obtained higher yields of grain. This problem of the need of liming paddy soils to increase crop yields has received attention at Central Rice Research Institute, Cuttack, India for the last few years and mineralising action of lime on soil nitrogen has been under investigation. In field experiments addition of large dressing of lime, at the rate of 2,000 lbs. per acre, has given highly significant yield increase of grain, about 13% more over a no-lime yield of 2,632 lbs. per acre. The exact function of lime to increase nutritional status of soils resulting in higher grain yields has been examined from laboratory and field studies and some of the results obtained are summarised below.

In laboratory studies, mineralising action of lime on soil nitrogen has been studied under incubated conditions at a temperature of 35°C. Lime was added at the rate of one gram for each 100 gram sample of soil and the soil was kept water-logged for a period of five weeks. Estimation of NH_3–N and NO_3–N in the samples was done at periodical intervals. Results are given in Table 1.

Table 1

Parts Per Million of N in Soil at Different Periods of Water Logging. (Calculated on Oven-dry Basis)

S. No.	Treatment		Period of Water Logging				
			Start	7 days	14 days	21 days	35 days
1.	Soil	NH_3–N	10	20	22	24	31
		NO_3–N	5	4	4	4	4
2.	Soil+Lime (added before water logging)	NH_3–N	11	38	45	46	50
		NO_3–N	4	5	4	4	4

S. No.	Treatment		Period of Water Logging				
			Start	7 days	14 days	21 days	35 days
3.	Soil+Lime (added 14 days after water logging)	NH_3–N	11	–	–	32	48
		NO_3–N	4	–	–	4	4
4.	Soil+Green Matter to supply 25 p.p.m. nitrogen	NH_3–N	10	34	38	49	50
		NO_3–N	4	3	3	4	4
5.	Soil+Green Matter+Lime added before water logging	NH_3–N	11	42	52	55	61
		NO_3–N	6	3	4	4	4
6.	Soil+Green Matter+Lime added 14 days after water logging	NH_3–N	10	–	–	50	54
		NO_3–N	4	–	–	4	4

Results show that lime added to rice soils under flooded conditions increased mineralisation of soil nitrogen and released about 100% more NH_3–N from the soil, during the first 14 days of water logging. At later periods also more NH_3–N was available in the lime treated soils and the total extra nitrogen released by lime up to a five–week period was as much as supplied by an application of 25 p.p.m. of nitrogen in the form of green matter.

Confirmation of the beneficial effects of lime on soil nitrogen has also been obtained from field studies of un–oxidised samples of soil from lime and no–lime plots of transplanted paddy fields. In an experiment which is in progress to study the effects of lime on yield and nutrient uptake by crops, periodical examination of soils for NH_3–N content has been undertaken. Lime has been applied in this experiment at 2,000 lbs. per acre, top–dressed, just before transplanting. Results of such studies on soil reaction to the application of lime and NH_3–N content in water logged conditions, 14 days after transplanting, are given in Table 2.

Table 2

Soil Reaction and Parts Per Million of NH_3–N in Water–Logged Soils. (Calculated on Oven–dry Basis)

Plot No.	No–Lime		Lime	
	PH	NH_3–N	PH	NH_3–N
I.	6.2	16	8.1	32
II.	6.5	14	7.0	34
III.	6.5	14	7.4	30
IV.	6.4	16	9.7	34

Lime applied in field plots has maintained the soil reaction to slight alkalinity even after 14 days of application and has resulted in production of 100% more NH_3–N in the soil, corresponding to an application of 30 lbs. of N per acre in ammoniacal form. Further studies on the uptake of nutrients and the effects on growth and yield of the crop are in progress.

SEED MULTIPLICATION AND DISTRIBUTION SCHEMES IN INDIA, 1953 [1]

India, being a Union of States, has no seed multiplication and distribution scheme, but each of the States has one of its own.

In Andhra State, there are about $4\frac{1}{2}$ million acres under rice, and every season improved seed to cover $\frac{1}{2}$ million acres is distributed. This seed is produced by seed farmers under the supervision of the State Department of Agriculture, and accerding to the scheme a cultivator can renew his seed every two or three years.

In Assam State, nucleus seed of improved strains is produced on Government farms and is given for multiplication to registered seed growers on the condition that they will sell 60 percent of their produce to the Government for distribution. In 1952, 113.6 tons of nucleus seed were produced.

In Bombay State, out of 750,000 acres suited for improved strains, 670,000 acres have already been covered with them and in 1954 it was planned to distribute the seed of improved strains in another 59,000 acres, thus bringing a total of 730,000 acres under the improved strains. The seed multiplication and distribution scheme was initated 8 years ago and the experience has shown that cultivators attach more value to the seed produced on Government farms than thas by registered seed growers, hence it wat decided to increase the production of the nucleus seed on the Government farms, to be multiplied in Community Project and National Extension Block areas.

In Hyderabad, the seed multiplication and distribution scheme was reorganised in 1950. The rice crop in the State covers an area of 1.45 million acres and it is reported that 400,000 acres or nearly 28 percent of the area is now covered with improved strains. In 1950, 939 tons of improved seed were distributed to cover 25,000 acres. In 1953, 5,419.3 tons of improved seed were distributed to cover 200,000 acres. In 1951, "The Hyderabad Improved Seed and Seedlings Act No. 28" was passed by the Legislative Assembly, under which a farmer is prohibited from growing any other variety

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1 *Submitted by the Indian Delegation to the Fifth Meeting of the Working Party on Rice Breeding held in Tokyo, Japan, October, 1954.*

except specified ones," It seems good progress has been made in bringing the rice area under the recommended strains.

In Madhya Pradesh State, seed of improved strains is distributed to cultivators at subsidised rates from private seed farms and multiplication centres. Since the inception of the scheme in 1944 to the end of 1954, 52,555 tons of seed had been distributed and it was planned to distribute 9,151.8 tons of seed in 1954. The present supply of improved rice seed is not sufficient to cover the entire rice area in the State, due to the smallness of Government farms to produce enough nucleus seed. Hence it was proposed to establish one Government seed demonstration farm for every 100 villages in the National Extension Service Block. Legislation for compulsory use of improved seed in selected areas is also under consideration.

In Madras State, nucleus seed of improved strains are produced on Government farms and multiplied by selected seed growers and distributed to farmers through State agricultural depots. In 1954, a village seed farm scheme was introduced. Under this scheme primary seed will be distributed every year to selected cultivators in each village at the rate of one lb. per acre through village agricultural associations. The seed thus multiplied by the selected farmers will be distributed to some other cultivators in the village. It is expected that for every pound of primary seed 50 lbs. of pure seed will be produced and in the following year there will be sufficient seed produced for the whole village.

In Orissa State, the seed multiplication and distribution scheme was started in 1942, and since then there has been a considerable expansion of Government seed farms for the production of nucleus seed to be multiplied by registered seed growers in the State. Since 1946 a total of 11,959 tons of nucleus seed was produced.

In Travancore-Cochin State, 800,000 acres are under rice, with 1/8 of them planted to improved strains.

BREEDING RICE FOR IMPROVED MILLING AND COOKING QUALITIES

C. Roy Adair

Research Agronomist, Field Crops Research Branch
Agricultural Research Service, U.S. Department of Agriculture

The milling and cooking qualities of rice are important factors to be considered in breeding improved varieties. Although these characteristics have been studied for many years, they have not received sufficient emphasis in planning rice breeding programs in the United States. Varieties have been released to farmers that were highly satisfactory in the field and produced good yields but they were not acceptable to the trade

and consumers because of low mill outturn or poor cooking quality. We are now fully aware of the importance of these quality factors. Plans are being developed to provide facilities to test all selections for milling and cooking qualities.

It is well known that the short – and medium-grain varieties usually produce higher mill yields of both head and total milled rice than do most long-grain varieties. There are also differences in milling quality within grain types. Blue Rose, a medium-grain variety, usually is higher in milling quality than is Zenith, a variety of similar type. Likewise, of the long-grain variety, Bluebonnet is generally higher in milling quality than Century Patna 231.

The better long-grain rices are preferred to short – or medium-grain varieties by most consumers in the United States and Cuba. The preference is because these long-grain varieties have the qualities which have been described as "the kernels are tender but whole; they keep their own distinct shape, and in color they are white or creamy" (Stienbarger, 1935). The varieties Rexoro, Bluebonnet, Nira and Fortuna have these qualities when properly cooked. However, other long-grain varieties such as Century Patna 131, Rexark and Lady Wright take a longer time to cook, are more or less pasty, or they break up in cooking. Short – and medium-grain varieties are usually not as "dry" as good long-grain varieties when cooked. This may be due to the difference in size and shape which require that the thick grain be boiled a long time to get the center of the kernel cooked, or it may be due to differences in the chemical composition of the endosperm (Rao, et al, 1952).

We have a fairly satisfactory method for determining the milling quality of small samples. The rough rice sample is cleaned to remove all foreign material and immature, hulled and broken kernels. A sample of 125 grams is then carefully weighed and hulled in a McGill Sheller. The brown rice is weighed to determine the percentages of hulls and brown rice. The brown rice is then milled for 30 seconds in a small McGill Miller with a 15-Pound weight on the pressure cover. The milled rice is then aspirated to remove the bran and polish, and weighed to determine the total milling yield. The whole and broken grains are then separated. Sieves or indented trays aid in separating the whole and broken grains, although the final separation is done manually. Broken grains that are three-fourths of the grain or more are considered whole grains.

The large McGill Miller is used for samples from larger plots. This device requires a 1,000-gram sample. Except for the differnce in sample size, the testing method is essentially the same as with the small Miller. The total milled rice is determined from the weight of the entire milled sample. The milled rice is then divided in a sampler, and only one-sixteenth of the sample is analyzed for whole and broken kernels to determine the percent of head rice.

The samples obtained from the milling tests are used to determine cooking quality.

Cooking quality has been determined by putting 25-gram samples in small "tea balls" and cooking in a covered saucepan.

The rice is cooked in the water from 12 to 20 minutes and then steaméd over the water from 5 to 15 minutes. The samples are then tested for such characteristics as texture, color flavor, odor, expansion and water absorption.

There is a comparatively small but important market for parboiled or "converted" sice for the canned food trade in the United States. Rice that is combined with meat, and canned, must be cooked under pressure for about 40 minutes in order to properly process the meat. A variety of rice must possess special qualities in order to withstand this long cooking time and still retain its shape and not become mushy. Rexoro, Nira and Texas Patna are satisfactory for canning but many varieties such as Bluebonnet,Century Patna 231 and others are not suitable. It so happens that all commercial varieties that can be used for this purpose have a rather long-growing season. None of our early and midseason commercial varieties is satisfactory. However, preliminary tests indicate that certain available early-maturing lines withstand this long cooking process. We are hopeful that varieties in all maturity groups can be developed that will be suitable for this purpose.

The first step in setting up a central quality laboratory at the Rice-Pasture Experiment Station, Beaumont, Texas, was taken this past season, and milling quality tests were run on all of the varieties in the Uniform Yield Nurseries. However, it has not been possible to run cooking quality tests on all of this material.

We are increasing the amount of work on testing the milling and cooking quality of varieties and selections in the breeding program, This work will be divided into two parts. The first part will be the routine testing of the milling and cooking quality of varieties and selections by the mothods now available. The other part will be to devise new techniques that are faster and/or more accurate for determining these characteristics of rice. One possibility would be to dovelop methods that would require only very small sâmples and would not be laborious, so that many plants and lines from early segregating generations can be tested.

We are hopeful that a well-integrated progarm will be established in which the U.S. Department of Agriculture, the Agricultural Experiment Stations in the rice-growing states, and commercial rice-processing companies will work together to develop rice varieties of high milling quality with the desired cooking qualities.

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PROBLEMS OF TILAPIA CULTURE IN RICE FIELDS IN TAIWAN

T.P. Chen

Senior Specialist, Plant Industry Division.
Joint Commission on Rural Reconstuction, Taiwan

The culture of Tilapia in rice fields has played an important role in the increase of fish production in recent years in Taiwan. The acreage of rice fields used for Tilapia culture has increased from 3,438 hectares in 1952 to about 8,000 in 1954, which is about 1.5% of the total acreage under rice. The production of Tilapia from rice fields totalled 2,465 metric tens in 1953, but the total production of Tilapia, including that from ponds, reached 6,300 metric tons, which gave Tilapia a fourth ranking place in term of quantity produced on the list of Taiwan fish production.

Inspite of the apparent success, the culture of Tilapia in rice fields has met with many difficulties which are yet to be solved.

The first difficulty is the unfavourable climatic condition in Taiwan. The onset of both the warm and cold weather is so sudden and uncertain that many a time Tilapia planted at the same time with rice transplanting were killed by chills. Thus, Tilapia have at most a growing season of only seven months in the Island.

The next problem is how to obtain enough Tilapia fry to stock rice fields at the time of spring planting. Unlike carp and most other fish, which spawn only once a year but produce an immense number of eggs at each spawning, Tilapia spawn many times a year but produce only hundreds of eggs each time. As Tilapia do not spawn in Taiwan until the weather gets warm, it is impossible to supply the large number of fry needed for planting unless one goes to the expense of keeping a large number of breeders in large hatcheries.

The occurrence of drought and failure of irrigation often cut the growing season of Tilapia even shorter. Only in very few localities can Tilapia be reared in rice fields without interruption in the seven month growing period.

The infestation of insects or diseases necessitates the application of pesticides, which would be harmful to the fish if they were not removed from the fields. This, however, does not happen very often, as the flooded fields seem to be comparatively free from pests.

Another problem is that of overcrowding. Tilapia fingerlings planted in the rice fields reach maturity in about two months and start breeding. Instead of thousands, there may be a million fish in one hectare of rice fields. Unless properly thinned, a large majority of the fish will remain fingerlings at the end of the season.

Most other countries where Tilapia are cultured do not have the proplems mentioned above, because they have more favourable climatic conditions. Taiwan is the only country where Tilapia culture is attempted under such unfavourable conditions. The attempt is believed to be justified considering the desperate need for protein food in a country where the arable land is limited and the population large.

USE OF RICE-FIELDS FOR FISH CULTURE IN THAILAND *

Although rice and fish are two inseparable items of food to the Thai people and from time immemorial Thai farmers have obtained considerable amount of fish from their rice fields, actual using of paddy-fields for fiish culture has been attempted only recently – in fact; it is only at an experimental stage.

The species of fish used for experimentation are:

1. Common carp *(Cyprinus carpio)*
2. Sepat Siam *(Trichogaster pectoralis)*
3. Tilapia *(Tilapia mossambica)*
4. Kissing Gouramy *(Helostoma temmincki)*

The size of fish stocked is mostly about 6–10 cms. long. Experience has shown that, because of the presence of snake-head fish (Ophicephalus), fingerlings of less than 5 cms. long have little chances of survival.

The number of fish stocked in each hectare of rice field is as follows:

1. Common carp	– 2,000–2,500
2. Sepat Siam, Tilapia, Kissing Gouramy	– 4,000–5,000

The stocking material are produced and reared in hatcheries. They are stocked into rice fields about 7–10 days after rice seedlings have been transplanted, and are harvested at the time when rice is harvested.

The rice fields which are intended for stocking fish have their bunds strengthened and raised in height to prevent over-flooding. The inlets and outlets are screened with bamboo screens. Trenches of about 1 m. wide and 1/5 m. deep were constructed along the edge of the field, serving as retreats for the fish.

In places where water supply is available, culturing fish in rice fields between two rice crops has also been tried with fairly good results.

Although it is too early to draw any definite conclusions from the experiments, yet we are convinced about the following points:

(1) With proper control of water level and fish enemies (especially snake-head fish), about 80–100 kgs. of fish can be produced in one hectare of field per year in Thailand, without application of supplementary feeding.

(2) Among the kinds of fish tried, common carp and Sepat Siam seem to be able to survive against fish enemies better than Tilapia and Kissing Gouramy.

(3) In the rice fields where snake-head fish can be controlled effectively, Tilapia grow very well.

(4) Fish stocked in rice fields are able to eat up large quantities of weeds, worms and insect larva which are either directly or indirectly injurious to rice plants.

* *Submitted by the Thai Delegation to the Fourth Session of the International Rice Commission held in Tokyo, October, 1954. The experiments and demonstrations listed in the paper have been carried out under the technical supervision of Dr. S.W. Ling, FAO Fishery Expert stationed in Thailand.*

(5) The activities of fish seem to be beneficial to rice plant growth.

(6) Metabolic wastes of fish are good fertilizers to rice fields.

(7) Presence of fish in rice fields seems to increase the production of rice.

Since fish is highly esteemed and badly needed by our people, common carp of about 150 gms. in weight will be acceptable as pan fish to them in rural areas.

The Thai farmers have recently developed great interest in culturing fish in their rice fields too.

It has been estimated that Thailand has about 900,000 hactares of rice fields and other crop lands suitable to be developed for culturing fish. Close cooperation between the Department of Rice and the Department of Fisheries has been established conducting experiments designed to find out the various aspects of this subject along the following lines:

(1) effects on the production of rice by the presence of fish;

(2) kind or kinds of fish suitable for rice fields in different parts of Thailand;

(3) suitable size and number of fish to be stocked per unit area;

(4) combination of different species of fish suitable for rice fields;

(5) possible optimum production of fish in rice fields, with and without application of supplementary feeding; and

(6) improvement of methods for the control of water level and fish enemies.

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